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RESPONSES OF ALBINO RATS TO HIGH RICE BRAN DIETS: EFFECTS OF TYPE OF RICE BRAN AND LEVEL OF X-ZYME™ (An Exogenous Enzymes + Probiotics Feed Additive)

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ORIGINAL ARTICLE

ABSTRACT: *The experiment was conducted to determine the effects of high (60%) rice bran-based diets with rice brans of different qualities (Type A-poor and Type B-good) and 2 levels of X-zyme™ (an exogenous enzymes+probiotics feed additive) on the growth performance and carcass characteristics of albino rats. Thirty albino rats were randomly allotted to five dietary treatments, T1 (maize-based, Control), and four other diets containing rice bran with differing quality (A and B) plus X-zyme™ at two levels (250 and 500mg/kg) labeled: T2 (Type A RB+250mg X-zyme™ per Kg feed), T3 (Type A RB+500mg X-zyme™ per Kg feed), T4 (Type B RB+250mg X-zyme™ per Kg feed) and T5 (Type B RB+500mg X-zyme™ per Kg feed). There were 6 rats on each treatment, housed individually in plastic cages and each rat served as a replicate. Feed and water were provided ad libitum and their growth performance monitored for 28 days after which the rats were euthanized for carcass measurements. Data collected showed significant (P<0.05) differences in weight gain, feed intake, feed efficiency and the feed cost per 100g gain with better growth performance trends for treatments T1 (Control), T4 and T5 (Type B rice bran). Also, there were significant differences in the weights of kidneys, liver, lungs, heart and the empty stomach. It was concluded that, the composition of agro industrial by-products such as rice bran may have an effect on how efficiently they are utilized by monogastric farm animals even when some nutrient releasing and growth promoting feed additives have been added.*

Keywords: *Exogenous Enzymes, High Levels, Probiotics, Quality, Rice Bran.*

INTRODUCTION

Feeding has become a major cost item in the production of monogastric livestock such as pigs and poultry contributing to about 70% of the total cost of production in Ghana (Boateng et al., 2008). This may be due to the fact that most of the ingredients used in non- ruminant animal feed are also being used as food for humans. Donkoh and Attoh-Kotoku (2009) had emphasized that maize which is the major energy source in poultry diets for example is a major staple for humans in most sub- Saharan African countries. Thus, some farmers have resorted to using agro-industrial by-products (AIBP) which are cheap and readily available. Atuahene et al. (2000) identified rice bran as one such product that is relatively inexpensive and can be used as an alternative for maize; which has appropriately been described as being expensive and backbreaking for most non- ruminant livestock farmers. Chung (2001) had explained that there are bound to be differences in the chemical composition of some of these feed ingredients depending on the source from which they were obtained.

Boateng et al. (2013) indicated that some farmers use rice bran in feeding their monogastric farm animals in Ghana even though there is a dearth of information available in support of the nutritive value and the extent to which it supports growth and concluded that, with the addition of suitable dietary enzyme complexes which will help degrade the complex non-starch polysaccharides (NSP) in this by-product, up to 60% can be fed to monogastric farm animals. Furthermore, probiotics have been noted (Ensminger et al., 1990) to accelerate biological processes and improve the intestinal microbial balance as well as improve the utilization of nutrients when fibrous products are fed to monogastrics. Therefore, this study was done to ascertain the effects of feeding two different rice bran-based diets supplemented with 2 levels of X-Zyme™, an exogenous enzymes and probiotics complex on the growth performance and carcass characteristics of albino rats.

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MATERIALS AND METHODS

Location and duration of Experiment

The study was carried out at the Livestock Section of the Department of Animal Science, Faculty of Agriculture, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana and it lasted a period of four weeks.

Source of feed ingredients

Two rice bran (RB) types based on the degree of adulteration with rice hulls/husk were obtained and used in the experiment. Type A, which contained more hulls/husks and considered low quality, and Type B, rice bran which contained less hulls/husks and perceived to be of higher quality were obtained from two different locations in the Ashanti Region of Ghana. All other ingredients used in this experiment including the additive, X-zyme™ were obtained from the open market in Kumasi.

Experimental Animals, Feeds and Design

Thirty albino rats (15 males and 15 females) with an average initial live weight of 84g were allocated to 5 dietary treatments namely; T1 (Control, a maize-based diet), T2 (Type A RB+250mg X-zyme™/ kg feed), T3 (Type A RB+500mg X-zyme™/ kg feed), T4 (Type B RB+250mg X-zyme™/ kg feed) and T5 (Type B RB+500mg X-zyme™/ kg feed);in a Completely Randomized Design (CRD) experiment. Each treatment was replicated six times and there was a rat in each replicate. Each treatment consisted of 3 males and 3 female albino rats. Table 1 is a summary of the composition of the different dietary treatments used in the experiment.

Table 1 - Percentage composition of the five diets

Feed ingredient	Dietary Treatments T1	T2	T3	T4	T5
	Type of RB				
	-	A	A	B	B
Xzyme™/kg diet, mg	0	250	500	250	500
Maize	65.0	11.0	11.0	11.0	11.0
Rice bran	-	60.0	60.0	60.0	60.0
Wheat bran	13.40	13.40	13.40	13.40	13.40
Fishmeal	8.0	5.0	5.0	5.0	5.0
Soya bean meal	11.60	8.60	8.60	8.60	8.60
Oyster shell	1.25	1.25	1.25	1.25	1.25
Common salt	0.25	0.25	0.25	0.25	0.25
Dicalcium phosphate	0.25	0.25	0.25	0.25	0.25
Vitamin-trace mineral premix*	0.25	0.25	0.25	0.25	0.25
Calculated Composition (%)					
Crude protein	17.94	17.95	17.95	17.95	17.95
Crude fibre	4.00	10.02	10.02	10.02	10.02
Calcium	1.11	0.90	0.90	0.90	0.90
Phosphorus	0.60	1.41	1.41	1.41	1.41
Lysine	0.96	0.94	0.94	0.94	0.94
Methionine	0.36	0.35	0.35	0.35	0.35
ME (Kcal/kg)	3165.5	2832.5	2832.5	2832.5	2832.5

*Vit. A, 12,000 IU; Vit. D, 200 IU; Vit. E, 10 IU; Vit. K, 0.002mg; Vit. B_1,0.002mg; Vit. B_2, 0.0045mg; Vit. B_6, 0.004mg; Vit. B_{12}, 0.01mg; pantothenic acid 0.012mg; nicotinic acid 0.003mg; folic acid 0.001mg; biotin 0.015mg; manganese 0.06mg; iodine 0.001mg; zinc 0.05mg; iron 0.025mg; copper 0.005mg; selenium 0.001mg/kg.

Housing, Management and Feeding of Rats

The rats were housed individually in rectangular plastic containers measuring 27×21×15cm, each of which was covered with wire mesh to aid ventilation. Feed was provided in a cylindrical metallic feeding troughs fixed to a corner of the container and water was given to rats by means of a glass bottle fitted with glass nipples which were placed on top of the wire mesh on each cage. Feed and water were provided *ad libitum*. All recommended health and biosecurity practices were regularly carried out during the course of the study.

Data Collection

Weekly feed intake and weight gain were recorded and used as basis in calculating daily feed intake, daily weight gain and the feed conversion ratio. The prevailing market prices of the ingredients used in the experiment were employed in determining the price per 100g of feed and the amount of money needed for each rat to gain

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100g of weight. At the end of the experiment, all rats were euthanized and the weights of viscera, liver, heart, lungs, spleen, kidneys and full and empty GIT were taken. Internal organ developments in relation to that of the total body were also calculated.

Statistical Analysis

All data collected on the rats were subjected to analysis of variance (ANOVA) using the Genstat (2007) Statistical Package (version 12.1) and the least significant difference (LSD) was used to separate the treatment means.

RESULTS AND DISCUSSION

Growth Performance

The growth performance of the rats fed the five experimental diets is as summarized in Table 2. There were significant ($P < 0.05$) differences in feed intake, weight gain and feed conversion ratio with rats on dietary treatment T4 consuming significantly ($P < 0.05$) more feed than those on T1 and T2. However, rats on treatment T3 and T5 recorded similar ($P > 0.05$) feed intakes to those on all other treatments. Also, rats on dietary treatments T4 and T1 recorded significantly ($P < 0.05$) better final weights and weight gains than those on T2 and T3. No significant ($P > 0.05$) differences were recorded between rats on treatment T5 and rats from all other treatments with regards to feed intake and weight gain. Dietary treatment T1 was more efficiently utilized ($P < 0.05$) by rats than dietary treatments T2 and T3; but treatments T4 and T5 however had similar ($P >0.05$) ratios as treatments T1 and T3 but their values were better ($P < 0.05$) than that of T2. The addition of more X-zyme™ (500mg/kg) reduced the rate of gain in the rats fed the good quality rice bran but these differences were not substantial ($P > 0.05$), the high quantity of X-zyme™ however resulted in numerically ($P > 0.05$) better gains in rats fed the poor quality rice bran. Boateng et al. (2013) observed significant ($P < 0.05$) changes in total feed intake, daily feed intake and FCR when rats were fed up to 60% RB-based diets supplemented with X-zyme™. Increased ($P < 0.05$) feed intake values were also registered when rats were given diets supplemented with a DFM product containing *Lactobacillus* strains (Anukam et al., 2005). The increase in feed intake for rats on the type B rice bran-based diets may be explained by observations of Conte et al. (2003), El-Deeb et al. (2000) and Teichmann et al. (1998), who all recorded increased feed intakes and live weight gains when broiler rations containing rice bran was supplemented with exogenous enzymes notably phytases and xylanases. Mabrigal et al. (1995) also recorded reduced feed intake and live weight gain but better efficiencies with increased inclusion of defatted rice bran.

Cost of production

The replacement of maize with higher levels of rice bran in the diets of rats resulted in a reduction in the cost of 100g of feed (Table 2). Dietary treatments containing rice bran of poorer quality (Type A) were slightly more expensive than those with prepared with the good quality (Type B) rice bran. This can be attributed to the fact that rice bran is not sold by the weight but by a flat rate per bag; thus, a bag with more husk will be expensive than one with a lower quantity of husk because husks are lighter.

It cost significantly ($P < 0.05$) more to raise albino rats on dietary treatment T2 than T4 and T5. Rats on the Control (T1) and T3 treatments recorded similar ($P > 0.05$) cost per 100g gain as animals on all other treatments namely T2, T4 and T5. Boateng et al. (2013) had earlier reported reduced feed cost per gram weight gain when levels of rice bran in rat diets were increase from 20 to 60%.

Table 2 - Growth and Economic Performance of the Rats

Parameter	Treatments					P	LSD	Sig.
	T1	T2	T3	T4	T5			
Type of RB	-	A	A	B	B			
Average initial weight, g	83.8	83.8	84.2	83.8	84.0	1.000	14.88	NS
Average final weight, g	186.5^{a}	133.3^{b}	143.8^{b}	190^{a}	165.7^{ab}	0.019	38.7	*
Total feed intake, g	341^{b}	330^{b}	377^{ab}	446^{a}	401^{ab}	0.020	72.3	*
Average daily feed intake, g	12.19^{b}	11.79^{b}	13.46^{ab}	15.91^{a}	14.31^{ab}	0.020	2.583	*
Average daily weight gain, g	3.66^{a}	1.76^{b}	2.13^{b}	3.79^{a}	2.91^{ab}	0.005	1.192	**
Feed conversion ratio	3.71^{c}	8.27^{a}	6.38^{ab}	4.29^{bc}	5.06^{bc}	0.004	2.362	**
Feed cost/100g(GH¢)$^{\#}$	0.101	0.057	0.058	0.054	0.055	-	-	-
Feed cost/100g gain(GH¢)	0.375^{ab}	0.471^{a}	0.370^{ab}	0.231^{b}	0.278^{b}	0.022	0.1471	*

*Significant (P<0.05), **Significant (P<0.01), NS=non-significant, LSD=Least significant difference, SIG=Significance, P=probability abc, Means on the same row bearing different superscripts are significantly different (P<0.05), #1Ghana cedi (GH¢) is equivalent to 0.5 dollars (US)

Carcass Characteristics

Table 3 shows a summary of the carcass composition and organ development of the rats on the five experimental diets. Weight of the kidneys, liver, lungs and empty GIT were significantly ($P<0.05$) different. The absolute weights of hearts for rats on the different treatments were also different ($P<0.001$). Generally the absolute

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values for most of the above parameters were considerably lower for the rats fed dietary treatments T2 and T3 and they follow similar trends as the final weights and the weight gain of the rats.

It is worth stating that the differences in the weights of all these organs were harmonious to the individual animals since the development of all organs as indicated in Table 3 were not significantly (P > 0.05) different. The relative weight of empty GIT was similar (P > 0.05) for rats on treatments T1, T3 and T5 which were significantly (P < 0.05) higher than those recorded for rats on treatment T2. Darkwa et al. (2013) recorded significantly lower relative weights for empty GIT in rats when they were fed diets containing varying levels of dried brewers' spent grains supplemented with Bergazym (an exogenous enzyme complex). High dietary fibre levels such as those contributed by the high inclusion levels of rice bran have been shown to affect the size and weight of the gastrointestinal tract in both pigs and rats (Pond et al., 1988; Anugwa et al. 1989; Hansen et al., 1992) but this was not exactly so in this study since rats on the Control diet (T1) recorded figures similar to, and in some cases, greater than their counterparts on the high fibre diets.

Table 3 -Carcass Parameters of the Rats

Parameter	Treatments					P-value	LSD	Sig.
Absolute weight (g)	**T1**	**T2**	**T3**	**T4**	**T5**			
Viscera	39.6	29.2	33.4	42.1	39.7	0.060	9.590	NS
Kidneys	1.468^{ab}	1.235^{c}	1.295^{bc}	1.557^{a}	1.475^{ab}	0.027	0.217	*
Liver	8.80^{ab}	5.86^{c}	6.81^{bc}	8.95^{a}	7.81^{abc}	0.028	2.121	*
Lungs	1.308^{ac}	1.073^{bc}	1.063^{c}	1.420^{a}	1.347^{ab}	0.043	0.281	*
Spleen	0.725	0.473	0.637	0.672	0.690	0.072	0.182	NS
Heart	0.743^{a}	0.465^{c}	0.577^{bc}	0.717^{a}	0.675^{ab}	0.001	0.130	***
GIT(full)	24.8	19.3	22.1	27.9	26.6	0.090	6.720	NS
GIT(empty)	11.17^{a}	6.48^{b}	9.16^{ab}	11.51^{a}	11.65^{a}	0.002	2.713	*
Organ developments (% of BW)								
Viscera	21.52	21.71	22.98	22.06	23.97	0.294	2.597	NS
Kidneys	0.807	0.935	0.897	0.822	0.895	0.099	0.107	NS
Liver	4.725	4.358	4.685	4.683	4.715	0.458	0.465	NS
Lungs	0.703	0.807	0.733	0.743	0.813	0.115	0.097	NS
Spleen	0.390	0.348	0.440	0.357	0.420	0.284	0.099	NS
Heart	0.405	0.353	0.398	0.377	0.410	0.557	0.078	NS
GIT(full)	13.48	14.28	15.17	14.57	16.05	0.138	2.026	NS
GIT(empty)	6.17^{a}	4.96^{b}	6.30^{a}	5.98^{ab}	7.04^{a}	0.015	1.114	*

*Significant (P<0.05), **Significant (P<0.01), NS=non-significant, LSD=Least significant difference, SIG=Significance, P=probability abc, Means on the same row bearing different superscripts are significantly different (P<0.05)

CONCLUSION

The addition of high levels of rice bran with higher husk content resulted in poor growth in rats compared to when rice bran with low quantities of husk and a maize-based diets were fed despite the addition of a complex of probiotics and exogenous enzymes. This experiment has shown that the composition of rice bran may have an effect on how efficiently it is utilized by monogastric farm animals when apparently appropriate exogenous enzymes and probiotic combinations have been added. The increase in the content of X-zyme™ added did not improve the growth performance of rats on the 2 rice-bran based diets. Farmers are therefore advised to check the quality of the rice bran they use in the quest to rear animals more efficiently and economically.

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